Papers

Effect of patients' age on management of acute intracranial haematoma: prospective national study

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Abstract

Objective To determine whether the management of head injuries differs between patients aged ⩾65 years and those <65.
Design Prospective observational national study over four years.
Setting 25 Scottish hospitals that admit trauma patients.
Participants 527 trauma patients with extradural or acute subdural haematomas.
Main outcome measures Time to cranial computed tomography in the first hospital attended, rates of transfer to neurosurgical care, rates of neurosurgical intervention, length of time to operation, and mortality in inpatients in the three months after admission.
Results Patients aged ⩾65 years had lower survival rates than patients <65 years. Rates were 15/18 (83%) *v* 165/167 (99%) for extradural haematoma (P=0.007) and 61/93 (66%) *v* 229/249 (92%) for acute subdural haematoma (P<0.001). Older patients were less likely to be transferred to specialist neurosurgical care (10 (56%) *v* 142 (85%) for extradural haematoma (P=0.005) and 56 (60%) *v* 192 (77%) for subdural haematoma (P=0.004)). There was no significant difference between age groups in the incidence of neurosurgical interventions in patients who were transferred. Logistic regression analysis showed that age had a significant independent effect on transfer and on survival. Older patients had higher rates of coexisting medical conditions than younger patients, but when severity of injury, initial physiological status at presentation, or previous health were controlled for in a log linear analysis, transfer rates were still lower in older patients than in younger patients (P<0.001).
Conclusions Compared with those aged under 65 years, people aged 65 and over have a worse prognosis after head injury complicated by intracranial haematoma. The decision to transfer such patients to neurosurgical care seems to be biased against older patients.

Introduction

Major trauma, particularly serious head injury, is associated with high mortality in people over 65 years.[1] It has been suggested that in older patients with a Glasgow coma score of 8 or less, it is more appropriate to err on the side of inactivity and withhold intensive treatment.[1 2] However, up to 60% of older patients with head injuries can make a full recovery[3] and take up no more resources than younger patients.[4]

In Scotland, age has been shown to be an independent factor in the process of trauma care in elderly patients.[5] We consider that outcomes are different for older patients with serious but potentially treatable head injuries compared with younger patients with similar injuries. This may be because of differences in management, particularly in rates of transfer to neurosurgical care.

Methods

We carried out a prospective observational study using data collected by the Scottish Trauma Audit Group, a centrally funded organisation that aims to improve trauma management in Scotland. It collects data on all injured patients who are admitted to hospital for three days or more or who die in hospital.[6] Data on 98% of all such patients are collected. Patients who arrive in the accident and emergency department in traumatic cardiorespiratory arrest are excluded unless the period of attempted resuscitation in the department exceeded 15 minutes. Physiological variables are routinely collected on arrival, as well as details of clinical care, surgical interventions, computed tomography, and transfer. Injuries are scored with the 1990 revision of the abbreviated injury scale, and all scoring is checked centrally to ensure accuracy and consistency.[7] Patient outcome is measured by survival to discharge or a maximum inpatient stay of three months. The audit group also records the occurrence of nine types of pre-existing conditions (cardiovascular, respiratory, disorders of the central nervous system, diabetes, renal, known malignancy, alcoholism, psychiatric, and drug misuse). For the purposes of this analysis, we excluded patients who died in emergency departments.

We compared the outcome and process of care among younger patients (13-64 years) and older patients (⩾65 years) who experienced trauma. In trauma literature 65 years is the conventional age used to define older patients. In Scotland a recent report on their health and wellbeing also used 65 years as the cut-off point to define older people.[8] During the four year period from 1997 to 2000 in 25 Scottish hospitals the Scottish Trauma Audit Group followed 3051 patients who had incurred serious head injury (score

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Table 1 Incidence and type of extradural haematomas or subdural haematomas according to age. Figures are numbers (percentage) of injuries

Haematoma site	AIS code	<65 years	≥65 years
Extradural haematoma			
Not further specified	140630	21 (13)	6 (33)
Small	140632	91 (54)	9 (50)
Bilateral	140634	3 (2)	1 (6)
Large	140636	52 (31)	2 (11)
Total		167	18
Subdural haematoma			
Not further specified	140650	47 (19)	20 (22)
Small	140652	139 (56)	46 (49)
Bilateral	140654	16 (6)	7 (8)
Large	140656	47 (19)	20 (22)
Total		249	93

AIS=abbreviated injury scale.

on abbreviated injury scale 3-6). To ensure a high degree of comparability of severity of head injury between age groups we limited our main analyses to patients who sustained either an extradural haematoma or an acute subdural haematoma but did not otherwise have a severe head injury (score on abbreviated injury scale ≥4).

We used Fisher's exact significance tests to compare proportions and Mann-Whitney U tests to compare measures of injury severity and physiological disorder between age groups. For rates of survival and of transfer to specialist neurosurgical care we also examined the effect of age as a continuous variable in logistic regression models with measures of injury severity, physiological status, and previous health status as covariates. We used a hierarchical log linear model to investigate the independent influences of age and pre-existing medical conditions on rates of transfer to specialist neurosurgical care (SPSS, 6.1, Chicago, IL). We give 95% confidence intervals for differences between proportions and estimates of logistic regression coefficients.

Results

Of the 3051 patients with serious head injuries, 1227 had an extradural haematoma or acute subdural haematoma. We excluded those who had other associated serious head injuries (score on abbreviated injury scale ≥4), so our main analysis was limited to 527 patients (416 aged <65 years and 111 aged ≥65 years, table 1).

Rates of survival and transfer to specialist neurosurgical care were significantly lower for older patients than younger patients (tables 2 and 3). The differences were independent of other factors contributing to survival and transfer, such as size of haematoma, other serious extracranial injuries, and measures of physiological status (table 3).

There were no significant differences between age groups in the proportions of patients with low Glasgow coma scores, serious extracranial injuries, or large haematomas (table 4). Hypotension or hypoventilation that would have precluded transfer was no more common in older patients than in younger patients (table 4).

Older patients were more likely to have a pre-existing medical condition. We therefore used a log linear model to test whether age and the presence of pre-existing medical conditions had independent effects on transfer to a neurosurgical unit. After we removed non-significant higher order interactions (minimum value P=0.2), four significant independent results remained: older patients were more likely than younger patients to have pre-existing medical conditions (χ^2=12.9, df=1, P<0.001) and subdural haematoma (χ^2=18.4, df=1, P<0.001), patients with a pre-existing medical condition were more likely to have a subdural haematoma than an extradural haematoma (χ^2=11.1, df=1, P<0.001), and age was independently related to transfer rates (older patients were less likely to be transferred to neurosurgical units after we controlled for type of haematoma and pre-existing medical conditions (χ^2=17.3, df=1, P<0.001) (table 5). Neither the occurrence of pre-existing medical conditions nor the type of intracranial haematoma had additional independent influences on transfer rates (χ^2=0.8, df=1, P=0.37, and χ^2=3.0, df=1, P=0.08, respectively) (table 5).

Other care measures

Early diagnosis of brain injuries is particularly important in older patients[9] so we might expect such patients to undergo computed tomography more quickly than younger patients. As a definite diagnosis was a prerequisite for further care we included in this part of the analysis all patients with a serious head injury (score on abbreviated injury scale ≥3) who underwent computed tomography (n=1534 because start of full data collection system for computed tomography began in August 1998). The median time to computed tomography was 2.3 hours in patients <65 years (n=1233) and 2.7 hours in patients ≥65 (n=301) (full computerised tomography data collection began in August 1998; P=0.001). Overall, 89 (30%) patients ≥65 had not had computed tomography within six hours of arriving in the emergency department compared with 261 (21%) younger patients (P=0.003).

Among the subset of 256 patients with an isolated extradural or subdural haematoma who went directly

Table 2 Survival and neurosurgical transfer among patients with extradural haematoma or subdural haematoma. Figures are numbers (percentage) of patients unless stated otherwise

	Extradural haematoma				Subdural haematoma			
Outcome	<65 years (n=167)	≥65 years (n=18)	% difference (95% CI)	P value	<65 years (n=249)	≥65 years (n=93)	% difference (95% CI)	P value
Transferred	142 (85)	10 (56)	29 (6 to 53)	0.005	191 (77)	56 (60)	17 (5 to 28)	0.004
Survived	165 (99)	15 (83)	NA	0.007	229 (92)	61 (66)	NA	<0.001
Survived after transfer	141 (99)	8 (80)	NA	0.01	183 (96)	41 (73)	NA	<0.001
Survived without transfer	24 (96)	7 (87)	NA	0.43	46 (79)	20 (54)	25 (6 to 44)	0.01

NA=not applicable because sample percentage >90%.

to a neurosurgical unit from the emergency department and had been referred to the neurosurgeons before transfer, 135/218 (62%) younger patients and 28/38 (74%) older patients had a documented referral from the emergency department (difference 14%, 95% confidence interval −4% to 27%, P=0.20). Although documentation of neurosurgical referral from the emergency department was incomplete, we found no evidence of age bias.

Of the patients with an isolated extradural haematoma or subdural haematoma, 171 (41%) younger patients and 44 (40%) older patients had a documented referral from the emergency department (difference 1%, −9% to 11%, P=0.91). Of those with documented neurosurgical referral, 135 (80%) younger patients and 28 (64%) older patients were transferred directly to a neurosurgical unit (difference 16%, 1% to 32%, P=0.029). This suggests that older patients were as likely to be referred from the emergency department as younger patients but that they were subsequently less likely to be transferred to the neurosurgical unit.

Of the patients with extradural haematoma or subdural haematoma who were transferred, we found no significant differences related to age in the proportion of patients who underwent neurosurgery (173/333 (52%) patients <65 *v* 26/66 (39%) patients ⩾65; difference 27%, −0.4% to 26%; P=0.08). Overall, 20/26 (77%) older patients who underwent neurosurgery survived (2/3 with extradural haematoma, 18/23 with subdural haematoma).

Prompt neurosurgical intervention in elderly patients is essential. For patients with extradural haematoma or subdural haematoma we found no evidence that older patients were operated on sooner after admission than younger patients: 146/173 (84%) patients <65 years were operated on within 24 hours of admission compared with 19/26 (73%) patients ⩾65 (difference 11%, −7% to 29%; P=0.17). Among patients with extradural haematoma or subdural haematoma who were transferred to a neurosurgical unit, the median length of admission in older patients was longer than that in younger patients (26 days *v* 9 days, P=0.007, and 17 days *v* 13 days, P=0.049, respectively).

Table 3 Results of logistic regression on factors affecting survival and transfer to neurosurgical care among patients with extradural haematoma or subdural haematoma

Explanatory variables*	Exp (B)† (95% CI)	P value
Dependent variable—survival		
Age	0.92 (0.89 to 0.94)	<0.001
Respiratory rate	119.9 (8.5 to 1688)	<0.001
Glasgow coma scale group		<0.001
Glasgow coma score 3-8	0.09 (0.04 to 0.21)	
Glasgow coma score 9-12	0.83 (0.83 to 0.26)	
Size of haematoma:		<0.001
Not further specified	9.90 (2.83 to 34.6)	
Small	6.01 (2.33 to 15.5)	
Bilateral	2.13 (0.52 to 8.76)	
Neurosurgical transfer	4.27 (1.77 to 10.3)	<0.001
Log odds constant −3.58		
Not in final model:		
Type of haematoma	0.33 (0.10 to 1.11)	0.06
Pre-existing medical conditions	0.91 (0.42 to 1.97)	0.80
Serious extracranial injuries	0.39 (0.13 to 1.11)	0.08
Systolic blood pressure	2.44 (0.47 to 12.7)	0.29
Goodness of fit of final model		χ^2=3.65, df=8, 0.89
Dependent variable—neurological transfer		
Age	0.96 (0.95 to 0.97)	<0.001
Serious extracranial injuries	0.23 (0.12 to 0.42)	<0.001
Size of haematoma:		<0.001
Not further specified	0.79 (0.35 to 1.79)	
Small	0.31 (0.16 to 0.60)	
Bilateral	0.92 (0.28 to 3.07)	
Respiratory rate	36.2 (2.82 to 464)	<0.001
Glasgow coma scale group		0.01
Glasgow coma score 3-8	1.99 (1.11 to 3.55)	
Glasgow coma score 9-12	2.16 (1.13 to 4.12)	
Log odds constant −3.39		
Not included in final model:		
Type of haematoma	1.00 (0.59 to 1.68)	0.99
Pre-existing medical conditions	0.97 (0.60 to 1.57)	0.90
Systolic blood pressure	1.94 (0.42 to 9.05)	0.39
Goodness of fit of final model		χ^2=4.63, df=8, 0.80

*Variables are listed in order they entered forward stepwise selection process. Age was entered as continuous variable, respiratory rate was categorised as 1 (values below 10) and 2 (10 or more); Glasgow coma scale group as 1 (Glasgow coma score 3-8), 2 (Glasgow coma score 9-12) and 3 (Glasgow coma score 13-15); haematoma size as 1 (not further specified), 2 (small), 3 (bilateral) and 4 (large); neurosurgical transfer as 0 (no transfer) and 1 (transferred); type of haematoma as 1 (extradural haematoma) and 2 (subdural haematoma); systolic blood pressure as 1 (<90 mm Hg) and 2 (⩾90 mm Hg); serious extracranial injuries as score on abbreviated injury scale ⩾3; and pre-existing medical conditions as 0 (absent) and 1 (present).
†Factor by which odds change when independent variable increases by one unit; values >1 indicate that odds increase as explanatory variable increases and values <1 indicate that odds decrease as explanatory variable increases.

Discussion

The results of our multicentre four year study support those of previous research that show that older patients with serious head injuries have poorer outcomes compared with younger patients with similar injuries. Older patients were also less likely to be transferred to specialist neurosurgical care, although there was no significant difference in their subsequent rates of neurosurgery. Age was a more important influence on neurosurgical transference than other concomitant factors, such as size of haematoma, the incidence of

Table 4 Features of patients with extradural haematoma or subdural haematoma. Figures are numbers (percentage) unless stated otherwise

	Extradural haematoma			Subdural haematoma		
Characteristics	<65 (n=167)	⩾65 (n=18)	P value	<65 (n=249)	⩾65 (n=93)	P value
Large haematomas (where size was specified)	52 (36)	2 (18)	0.33	47 (25)	20 (30)	0.42
Serious extracranial injury (score on AIS ⩾3)	16 (10)	0	0.37	40 (16)	14 (15)	0.87
Median Glasgow coma score	14	13.5	0.12	13	13	0.44
Glasgow coma score ⩽8	21 (13)	4 (22)	0.34	78 (31)	23 (25)	0.47
Median systolic blood pressure (mm Hg)	138	139	0.36	140	155	<0.001
Median respiratory rate (breaths/min)	18	18	0.51	18	20	0.019
Pre-existing medical conditions	43 (28)	9 (53)	0.049	102 (44)	57 (63)	0.003

AIS=abbreviated injury scale.

Table 5 Influence of age on transfer to neurosurgical facilities for four different groups of patients. Figures are numbers (percentage) of patients transferred

	<65 years	⩾65 years
No pre-existing medical conditions:		
Extradural haematoma	112 (84)	8 (50)
Subdural haematoma	129 (80)	34 (68)
One or more pre-existing medical conditions:		
Extradural haematoma	43 (88)	9 (67)
Subdural haematoma	102 (74)	57 (56)

serious extracranial injuries, and measures of physiological condition on arrival at hospital (including level of consciousness). Although older patients were more likely to have pre-existing medical conditions, significant differences in transfer rates related to age were still seen after we had controlled for these conditions. Age has previously been shown to influence independently the treatment of patients with blunt trauma in Scotland.[5] We conclude that age also seems to have an independent adverse influence on decisions about neurosurgical transfer.

Outcomes and process of care

Previous studies of outcomes of head injury in elderly patients have been limited by small numbers, inconsistency of inclusion criteria, or restriction to a single neurosurgical unit or rehabilitation centre.[10–13] Most studies, however, have shown significantly worse outcomes in older patients with head trauma, especially those with a pre-operative Glasgow coma score ⩽8.[12–15] On this basis, opinion leaders have argued that doctors dealing with older patients with head injuries should "err on the side of inactivity."[2] Indeed, a previous study of over 60 patients with fatal head injuries showed that 71% of those under 70 years old were transferred for specialist neurosurgical care compared with only 22% of those over 70.[9 16 17]

In common with the results of these studies, we found that older patients were more likely to die from their head injuries. Despite this, overall rates of survival among older patients with extradural haematoma or subdural haematoma were not insubstantial (83% and 66%, respectively). Although we do not have data that show the subsequent functional recovery of older patients with head injuries, specialist rehabilitation centres have reported home discharge rates of up to 46% in patients aged over 65 with severe closed head injury (compared with 82% of younger patients).[18]

Previous studies have also emphasised that intracranial haematomas are more common and larger in older patients than in younger patients.[10 11] Good outcomes from surgery in these patients rely on intervention before coma or pupillary dilation occurs.[9 13] Rapid identification and surgical decompression of haematomas may be the most important aspect of treatment in older patients. A more aggressive approach to performing computed tomography is therefore indicated.[10 19] Early computed tomography is particularly important in older patients because haematomas often present with atypical histories and often are not associated with focal signs.[20] In our study, patients aged ⩾65 years waited longer for computed tomography and did not receive a more rapid neurosurgical intervention than younger patients.

What is already known on this topic

Older patients with acute intracranial haematomas have significantly higher mortality and poorer functional outcome than younger patients with similar injuries

Intracranial haematomas are larger and more common in older patients with head injury than in younger patients

Early diagnosis and surgical intervention for operable lesions is a crucial factor in determining patients' outcomes

What this study adds

Older patients with acute intracranial haematomas were less likely to be transferred for specialist neurosurgical care than younger patients with similar severities of injuries, extracranial injuries, and physiological status at presentation

Significant differences in transfer rates related to age were still seen after pre-existing medical conditions were controlled for

Conclusions

Our study shows clear differences between age groups in the process of care and rates of specialist intervention in patients with head injuries. It is unclear to what extent these differences contribute to outcome in these patients or how many had valid clinical reasons for non-intervention. It is possible, however, that doctors' concerns over functional outcomes and survival rates in past studies may have produced a degree of scepticism over the worth of treating older patients with head injuries.

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